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ABSTRACT

This study examined factors influencing master's degree attainment in various disciplines. Discrete-time survival analysis was used to examine the records of 3,189 graduate students in business, engineering, health and human sciences, and visual and performing arts at a large midwestern university for 6 years. It was found that 2,070 students had received a master's degree within 6 years. Students in business tended to receive their master's degrees later than did students in the other three areas, while students in health and human sciences received their degrees more quickly. Older graduate students took more time to receive their degrees than younger students. It was also found that first-semester grade-point average had a significant positive effect on degree attainment, while gender, Graduate Record Examination (GRE) scores, and Graduate Management Admission Test (GMAT) scores had no impact on master's degree attainment. Five data tables and four figures appended. (Contains 19 references.) (MDM)

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Factors Influencing Master's Degree Attainment in Business, Engineering, Health and Human Sciences, and Visual and Performing Arts

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Factors Influencing master's Degree Attainment in Business, Engineering, Health and Human Sciences, and Visual and Performing Arts

ABSTACT

The present study examined factors influencing master's degree attainment process by following a sample of 3,189 graduate students in Colleges of Business, Engineering and Engineering Technology, Health and Human Sciences, and Visual and Performing Arts in a large Midwest university for six years. Discrete-Time Survival Analysis was used in the analysis. Two hundred and seventy-six students were censored due to follow-up time limitation. Twenty hundred and seventy students (71.1%) received a master's degree within six years. Eight hundred and forty-three students (28.9%) dropped out of graduate school or transferred to another institution. Master's degree attainment progress was significantly different among colleges. Students in Business tended to receive their master's degree slower than students in the other colleges in the sample. Students in Health and Human Sciences tended to receive their master's degree faster than students in the other three colleges. Older graduate students took more time to get their master's degree than younger students. First semester cumulative GPA had a significant effect on the degree attainment process. Overall, gender, GRE Verbal score, GRE Quantitative score, GRE Verbal score and GRE Quantitative score combined, and GMAT score had no impact on the master's degree attainment process.

Factors Influencing master's Degree Attainment in Business, Engineering, Health and Human Sciences, and Visual and Performing Arts

Survival analysis techniques (Cox, 1972; Cox & Oakes, 1984; Miller, 1981) have been developed for studying the occurrence and timing of events. Survival analysis can easily handle data with censored observations. Increasing number of studies applied survival analysis in educational research in recent years (Singer & Willett, 1993; Singer, 1993; Braun & Zwick, 1993; Willett & Singer, 1995; DesJardins & Pontiff, 1997; DesJardins, Ahlburg, & McCall, 1997; Xiao, 1997). Several studies (e.g., Zwick, 1991; Zwick & Braun, 1988) applied discrete-time survival analysis to examine the graduate school careers of students in various academic programs, for instance, at what pace does students reach milestones (e.g., advancement to candidacy, attainment of the Ph.D. degree) in their graduate careers. Civian (1990) used survival methods to study degree progress among students at the Harvard University Graduate School of Education. Ronco (1996) applied discrete-time survival analysis to study undergraduates' enrollment behavior--graduating, transferring, or dropping out. The study found that ethnicity (Hispanic vs. Non-Hispanic) was the only time-invariant variable significantly associated with graduating, transferring, or dropping out. Moore (1994) emphasized the role of discrete-time survival analysis in higher education enrollment management to identify who would need retention intervention, and when these students needed the intervention. Xiao (1997) found that gender, age, the first semester cumulative GPA, and GRE Verbal score had an impact on the Master of Science degree attainment process. Females tended to earn degrees faster than male students. Older students took more time to get their degree than their younger counterparts. The first semester cumulative GPA had positive effect on degree conferring. However, GRE verbal score had negative effect on degree conferring progress.

The present study intended to examine factors influencing master's degree attainment process in several discipline areas, and to examine whether college in which students chose to enroll had an impact on master's degree attainment. Demographic variables (such as college, gender and age) were included as independent

variables that might influence degree attainment process. Some academic background and admission test variables (GPA, GRE/GMAT scores) were also included as independent variables in the analysis.

Method

Students

The present study followed 3,189 students in four colleges---Business (BUSI), Engineering and Engineering Technology (ENGR), Health and Human Sciences (H&HS), and Visual and Performing Arts (V&PA), who started graduate programs in the fall semesters of 1987 through 1994 in a large Midwest public university. The students were followed for up to six years. There were 1,586 in BUSI, 269 in ENGR, 751 in H&HS, and 583 in V&PA when the students started their graduate programs; there were 1,566 male students and 1,623 female students. The median age of the students when they started their graduate program was 27 years.

Data

Each student's record contained demographic information, admission test scores (GRE-V, GRE-Q, GRE-V&Q, or GMAT), academic grades in the present graduate program, and persistence and degree conferred information for up to six academic years. Data in summer semesters were combined with data in fall semesters. Degrees conferred in the summer semesters were treated as if they were conferred in the spring semester. Thus in the present study each academic year consisted of two semesters. Students' persistence and degree conferred information was recorded for up to 12 semesters.

Analysis Strategies

Discrete-Time Survival Analysis using SAS LOGISTIC procedure (Singer & Willett, 1993) was used in the present study to examine the master's degree attainment process. The original person data was converted into person-period data (Figure 3 in Singer & Willett, 1993). In the new person-period data set, the ith person has J_i records, where J was the last period a person experienced. The time period in the present research was "semester". Nine discrete-time hazard models were developed to examine the master's degree conferring

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progress. The dependent variable was the logic of the hazard of conferring a master's degree. The independent variables were the time indicators, and the time indicators and each of eight variables assumed to affect the degree conferring process: college, gender, age, cumulative GPA at the end of the first semester, GMAT score, GRE-V score, GRE-Q score, and GRE-V and GRE-V&Q scores. The eight models are:

Model A: $\text{Logit}_e(h_{ij}) = a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}$

Model B: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GOLLEGE})_{ij}$

Model C: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GENDER})_{ij}$

Model D: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2i} + \ldots + a_jD_{jij}) + b_1(\text{AGE})_{ij}$

Model E: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GPA})_{ij}$

Model F: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GMAT})_{ij}$

Model G: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GRE-V})_{ij}$

Model H: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GRE-Q})_{ij}$

Model I: $\text{Logit}_e(h_{ij}) = (a_1D_{1ij} + a_2D_{2ij} + \ldots + a_jD_{jij}) + b_1(\text{GRE-V\&Q})_{ij}$

where D_j are a sequence of dummy variables indexing time periods. The J refers to the last time period observed for anyone in the sample. The a_j and b_1 are the parameters. Variables COLLEGE, GENDER, AGE, GPA, GMAT, GRE-V, GRE-Q, and GRE-V&Q are all categorical variables in the above models. Each of the continuous variables is coded into two categories: AGE: Age < 24, and Age>= 24; GPA: GPA < 3.0, and GPA >= 3.0; GMAT: GMAT < 500, and GMAT >= 500; GRE-V: GRE-V < 470, and GRE-V >= 470; GRE-Q: GRE-Q < 510, and GRE-Q >= 510; GRE-V&Q: GRE-V&Q < 990, and GRE-V&Q >=990.

The hazard probability is calculated according to the following formula:

$$h_{ij} = \frac{1}{1+e^{-(\alpha_1 D_{1ij} + \alpha_2 D_{2ij} + \cdots + \alpha_J D_{Aij} + \beta_1 Z_{1ij})}}$$

where Z_1 is any one of the independent variables other than the time indicators, and the survival probability is estimated using the following formula:

$$\hat{S}_j = \prod_{k=1}^{j} (1 - \hat{h}_k)$$

Model A examines the relationship between hazard to receive a degree and the semester time indicators, which serves as the baseline for determining whether other variables influence the event (receiving a master's degree). Model B through Model I are different from Model A in that each of them has included one more independent variable into the model. The change in the goodness-of-fit statistics (-2 log Likelihood) between Model B, C, D, E, F, G, H, I and the baseline model A tests the main effect of college, gender, age, GPA, GMAT, GRE-V, GRE-Q, and GRE-V&Q on degree conferring process, respectively.

Results

Results of the discrete-time survival analysis showed that college, age, and the first semester cumulative GPA had an impact on the master's degree attainment process. Students in Business tended to receive their master's degree slower than students in other colleges in the sample. Students in Health and Human Sciences tended to receive their master's degree faster than students in the other three colleges. Older students took more time to get their degree than their younger counterparts. The first semester cumulative GPA had positive effect on degree conferring process. The present study found that after 2.4 years in their graduate programs, 50% of students received a master's degree. It also found that students were most likely to receive a master's degree at the fourth and the sixth semester in graduate program.

Table 1 lists gender and college break down of the whole sample when students started their graduate programs. Table 2 shows the number of students who received their first master's degree by gender and college.

During the six academic years, 2,070 students received their first master's degree (71.1%), 843 students dropped out or transferred to other institutions (28.9%). Two hundred and seventy-six were censored due to follow-up time limit.

Insert Table 1 and Table 2 about here

Degree Attainment

When examining the degree attainment process, students who dropped out of graduate school or students who were still in graduate program but had not received a master's degree when the data collection ended were treated as censored. Table 3 shows the master's degree attainment process for the combined sample. The third column of Table 3 lists the number of students who received a master's degree during each time period (semester). The numbers of dropouts and censored due to time limitations are also listed in the table. The number of degrees conferred was larger for the fourth through sixth semesters in the graduate programs. The last column of Table 3 lists the proportion of students who were still in school and had not yet received a master's degree at the beginning of a semester, but subsequently received a master's degree during that semester. The proportion was larger for the fourth and the sixth semesters. For the whole students sample, the proportions were 38.0% for the fourth semester and 33.8% for the sixth semester. Figure 1 shows the fitted *Hazard probability* and *survival probability* curves for the whole sample. The hazard probability shows the probability that a student still in graduate program receiving a master's degree in a particular time period (semester). The survival probability curve in Figure 1 shows the probability of students in the sample having not received a master's degree. The opposite of the survival probability (one minus the survival probability) is the probability of students having received degree.

Insert Table 3 about here

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Insert Figure 1 about here

Factors Influence degree Attainment Process Other Than Time Indicators

Table 4 lists results for examining the significance of factors assumed to influence the master's degree attainment process for the whole sample. It shows the goodness-of-fit statistics for the hazard models fitted to the master's degree attainment data for Models B, C, D, and F. Column 2 of Table 4 lists the -2 log$L$ values of Model A—the baseline model that tests the effect of the time indicators alone. Column 3 lists the -2 log$L$ values of Model B, C, D, and E—the models that test the effect of the time indicators and college, gender, age, and GPA, respectively. The last two columns of Table 4 lists the χ^2 test results (change in -2 Log$L$ from the baseline models to the models that a main effect was added) to test the main effect of college, gender, age, and GPA. Students in BUSI used longer time to receive a master's degree than students in ENGR, H&HS, and V&PA ($p < .0001$). While students in H&HS finished their master's degree faster than the other three colleges (BUSI, ENGR, and V&PA) ($p < .0001$). Figures 2a and 2b show fitted hazard and survival functions containing the main effect of the time indicators and college: BUSI vs. the other three colleges—ENGR, H&HS, and V&PA (Figure 2a); and H&HS vs. the other three colleges—BUSI, ENGR, and V&PA (Figure 2b). AGE and GPA had an impact on the degree attainment process. Younger students took less time to finish their master's degree than their older counterparts ($p < .0001$). Higher GPA students took less time to finish their degree than lower GPA students ($p < .05$). Figure 3 shows the fitted hazard and survival functions describe the degree attainment process containing the main effect of the time indicators and AGE. Figure 4 shows the fitted hazard and survival functions describe the degree attainment process containing the main effect of the time indicators and GPA. Gender did not significantly influence the degree attainment process.

Insert Table 4, Figures 2a, 2b, Figure 3, and Figure 4 about here

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Similar to Table 4, Table 5 lists results for examining the significance of factors assumed to influence the master's degree attainment process for each of the four colleges—BUSI, ENGR, H&HS, and V&PA. Column 2 of Table 5 lists the -2 log$L$ values of the baseline model that test the effect of the time indicators alone. These values are different even within one college. This was because a few students did not have a GRE or GMAT scores and were excluded from the analysis when calculating the baseline model for testing the GRE/GMAT effect. As can be seen in the last column of Table 5, AGE played an important role in influencing the degree attainment process for students in BUSI and H&HS, but was not significant for students in ENGR and V&PA. The impact of GPA on degree attainment process was no longer significant in any of the four colleges. Gender had no significant effect on degree attainment process for three colleges (ENGR, H&HS, and V&PA). The gender variable had significant effect in BUSI ($p < .05$) in which male students received a master's degree faster than female students. None of the GRE variables had significant effect on master's degree attainment process, except for in ENGR, in which GRE-V and GRE-V&Q had significantly negative effect on degree attainment process ($p < .05$). In ENGR, students who had higher GRE-V or higher GRE-V&Q scores took more time to receive their master's degree than students who had lower GRE-V or lower GRE-V&Q scores.

Insert Table 5 about here

The Median Lifetime to Receive a Master's Degree

In Figure 1, if one draws a horizontal line from the 0.50 point of the survival probability, it intersects the survival probability curve. That intersect point corresponds to 4.7 semesters (semesters in program). After an average 4.7 semesters, 50% of the students would still have not received a master's degree. In other words, in 4.7 semesters, 50% of the students had already received a master's degree. This is called the *median Lifetime*. When the sample survival function equals .50, half students had received a master's degree and half had not. The estimated median lifetime to receiving a master's degree was 4.7 semesters, or 2.3 years for the whole sample. The estimated values of the median lifetime for BUSI, ENGR, H&HS, and V&PA were 4.9, 4.7, 4.0, and 4.6

semesters, respectively. The estimated median lifetime was 3.8 semesters for students younger than 24 years old and was 5.1 semesters for students whose age was at least 24 years old. The estimated median lifetime was 5.4 semesters for students whose GPA was less than 3.0 and was 4.7 semesters for students whose GPA was at least 3.0.

Discussion

The present study examined the master's degree attainment process using discrete-time survival analysis and demonstrated that Discrete-Time Survival Analysis was a useful tool for analyzing event occurrence in educational research. The results of the present study founded several demographic factors (age, gender) and several academic background factors (college enrolled, first semester cumulative GPA) that influenced master's degree attainment process. The study also found that the GRE/GMAT scores had no significant influence on students' degree attainment process.

Survival analysis is useful for analyzing student career data. By constructing hazard models of students' progress, it can examine student's degree attainment process. By using these techniques, one can determine at which stage students tend to finish their degree. One can also analyze the dropping out patterns of students. As Willett and Singer (1991) pointed out, "survival methods offer educational researchers much more than just a sophisticated data analytic approach--they offer a unified framework for appropriately modeling the many paths real students take through real schools" (p.427). The present survival analysis used only time-invariant variables such as gender, age, GRE scores. The time-invariant variables are constant over time periods. However, time-varying predictors (such as the amount of financial aid, part-time or full-time status, and educational or psychological interventions) usually vary over time periods and can easily be included in discrete-time survival analysis (Singer & Willett, 1993).

Many studies have examined the effect of GPA and GRE scores on degree completion behavior. Onasch (1994) studied a sample of 100 students who received an M.S. degree in Geology found that the results did not show any strong relation between undergraduate GPA, GRE scores, and degree completion time. However,

students with higher undergraduate GPA took less time to receive their degrees than those with low undergraduate GPA. Higher GRE scores predicted a longer time to receive an M.S. degree. Onasch (1994) suggested that awarding financial aid based primary on applicants' undergraduate GPA, not GRE scores. House and Johnson (1992) failed to find any significant relationship between GRE scores and the time needed to complete a master's degree in psychology. Sternberg and Williams (1997) found that the GRE did not predict second-year grades or any of the other indicators of graduate school success—the ability to think analytically, creativity, and practically, the capacity to teach and conduct research, and the quality of one's dissertation. The present study did not find any significant influence of GRE/GMAT scores on degree attainment process. The present study also confirmed Xiao's (1997) study in that age and the first semester cumulative GPA had significant influence on degree attainment process. However, The present study did not consider whether students enrolled as full-time or part-time in their graduate programs. The difference in degree attainment process might partially due to full-time/part-time status. Future studies will need to control students' enrollment status. The findings from the present study also have implications for selecting graduate applicants in these discipline areas.

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Table 1

Gender and initial colleges of students pursuing master's degree in Business, Engineering and Engineering technology, Health and Human Sciences, and Visual and Performing Arts in a Midwest university

(Fall 1987 through Fall 1994 cohorts combined)

	Business	Engineering and Engineering Technology	Health and Human Sciences	Visual and Performing Arts	Total
Female	1,022	223	71	250	1,566
Male	564	46	680	333	1,623
Total	1,586	269	751	583	3,189

Table 2

The first master's degree conferred for students of Fall 1987 through Fall 1994 cohorts combined in a Midwest university during six academic years follow-up, by gender and college

	Business	Education	Engineering and Engineering Technology	Health and Human Sciences	Liberal Arts and Sciences	Visual and Performing Arts	Total
Female	305	13	22	507	14	213	1,074
Male	640	1	135	47	18	155	996
Total	945	14	157	554	32	368	2,070

Table 3

Master's degree conferring process of students in a Midwest university

(Fall 1987 through Fall 1994 cohorts combined)

	Headcount at the		Censored			Proportion of		
Semes-	beginning	Received	Dropped	Censored due to	Total	Not received	Received	Receiving
ter	of semester	degree	out	time limit	censored	degree	degree	degree
1	3,189	16	280	0	280	0.995	0.005	0.005
2	2,893	83	209	0	209	0.966	0.034	0.029
3	2,601	205	87	0	87	0.890	0.110	0.079
4	2,309	877	81	141	222	0.552	0.448	0.380
5	1,210	159	44	0	44	0.480	0.520	0.131
6	1,007	340	30	64	94	0.318	0.682	0.338
7	573	95	22	0	22	0.265	0.735	0.166
8	456	142	15	38	53	0.182	0.818	0.311
9	261	45	10	0	10	0.151	0.849	0.172
10	206	63	4	33	37	0.105	0.895	0.306
11	106	20	9	0	9	0.085	0.915	0.189
12	77	25	52	0	52	0.057	0.943	0.325
Total		2,070	843	276	1,119			

Table 4

Goodness-of fit statistics for hazard model fitted to the degree conferring process for variables other than the time indicators for students in Business, Engineering and Engineering Technology, Health and Human Sciences, and Visual and Performing Arts in a Midwest university

(Fall 1987 through Fall 1994 cohorts combined)

	-2 Log *L*			
	Time indicators only	Time indicators plus another variable	Change in -2 Log *L*	
Independent variables in model			*df*	χ^2
B. Time indicators plus college:				
BUSI vs. other three colleges	11180.29	11207.12	1	26.84**
ENGR vs. other three colleges	11180.29	11180.31	1	0.02
H & HS vs. other three colleges	11180.29	11209.26	1	28.97**
V & PA vs. other three colleges	11180.29	11180.67	1	0.39
C. Time indicators plus gender	11180.29	11181.40	1	1.11
D. Time indicators plus age	11180.29	11280.35	1	100.06**
E. Time indicators plus GPA	11180.29	11186.82	1	6.53*

*$p < .05$ **$p < .0001$

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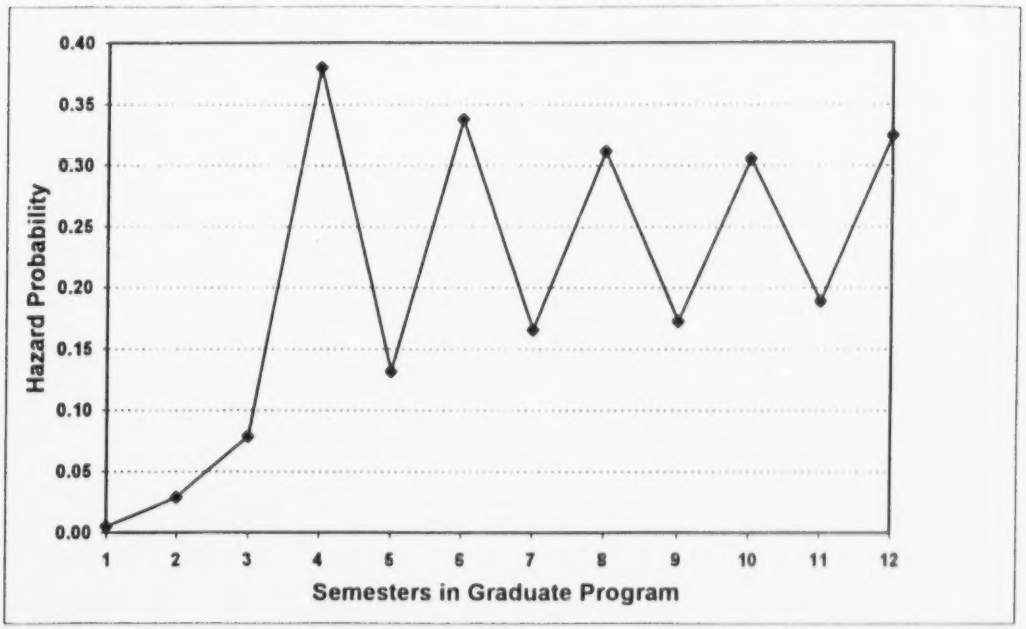
Table 5

Goodness-of fit statistics for hazard model fitted to the degree conferring process for variables other than the time indicators by college (Fall 1987 through Fall 1994 cohorts combined)

Independent variables in model	Time indicators only	Time indicators plus another variable	Change in -2 Log *L*	
			df	χ^2
Business				
C. Time indicators plus gender	5826.99	5832.47	1	5.48*
D. Time indicators plus age	5826.99	5891.37	1	64.38**
E. Time indicators plus GPA	5826.99	5827.73	1	0.74
F. Time indicators plus GMAT	5543.06	5544.41	1	1.35
Engineering and Engineering Technology				
C. Time indicators plus gender	872.74	874.32	1	1.58
D. Time indicators plus age	872.74	874.24	1	1.49
E. Time indicators plus GPA	872.74	874.70	1	1.95
G. Time indicators plus GRE-V	829.23	833.21	1	3.98*
H. Time indicators plus GRE-Q	829.23	830.02	1	0.79
I. Time indicators plus GRE-V&Q	829.23	835.24	1	6.00*
Health and Human Sciences				
C. Time indicators plus gender	1646.32	1646.33	1	0.01
D. Time indicators plus age	1646.32	1700.36	1	54.04**
E. Time indicators plus GPA	1646.32	1649.06	1	2.74
G. Time indicators plus GRE-V	1618.78	1619.77	1	0.99
H. Time indicators plus GRE-Q	1618.78	1621.72	1	2.94
I. Time indicators plus GRE-V&Q	1618.78	1619.45	1	0.68
Visual and Performing Arts				
C. Time indicators plus gender	2041.30	2041.54	1	0.23
D. Time indicators plus age	2041.30	2042.78	1	1.48
E. Time indicators plus GPA	2041.30	2044.56	1	3.26
G. Time indicators plus GRE-V	1734.66	1734.69	1	0.04
H. Time indicators plus GRE-Q	1734.66	1737.66	1	3.01
I. Time indicators plus GRE-V&Q	1734.66	1734.98	1	0.32

*$p < .05$ **$p < .0001$



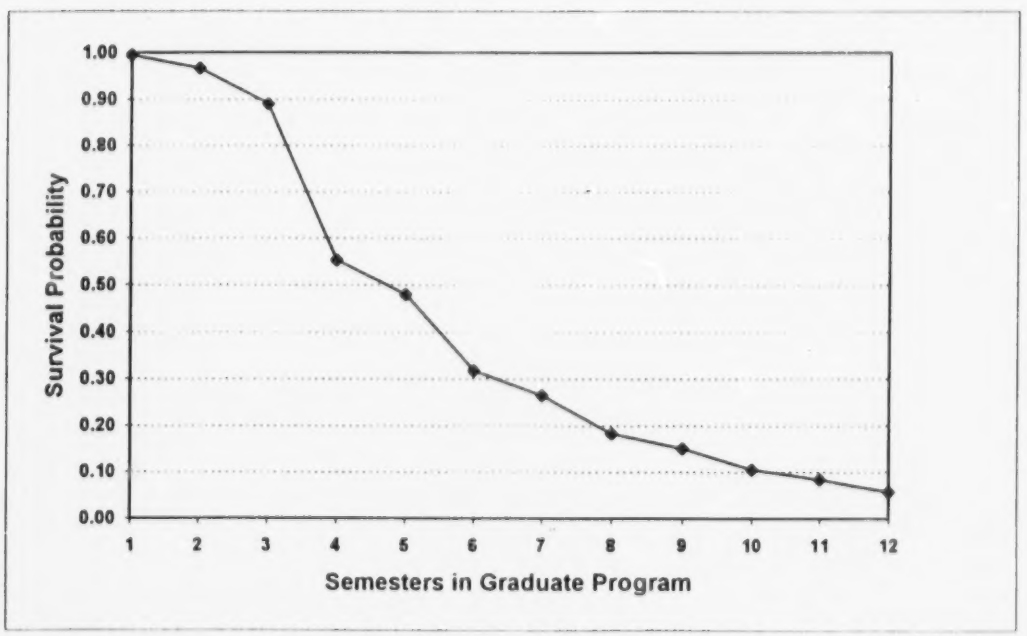
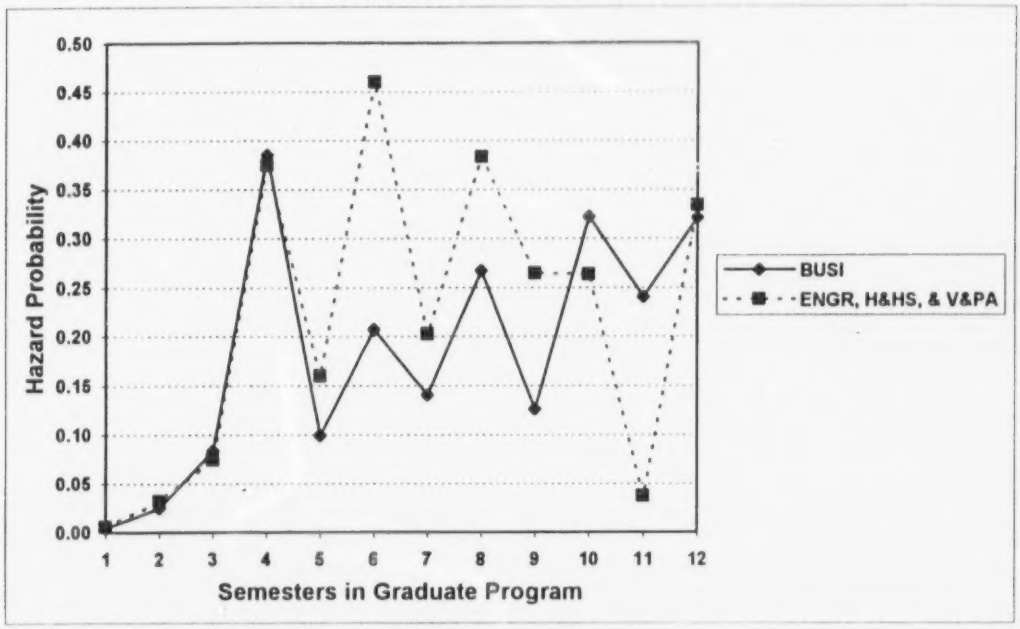


***Figure 1*.** **Fitted harzard and survival functions describe the degree attainment process, from a hazard model containing the main effect of the time indicators.**



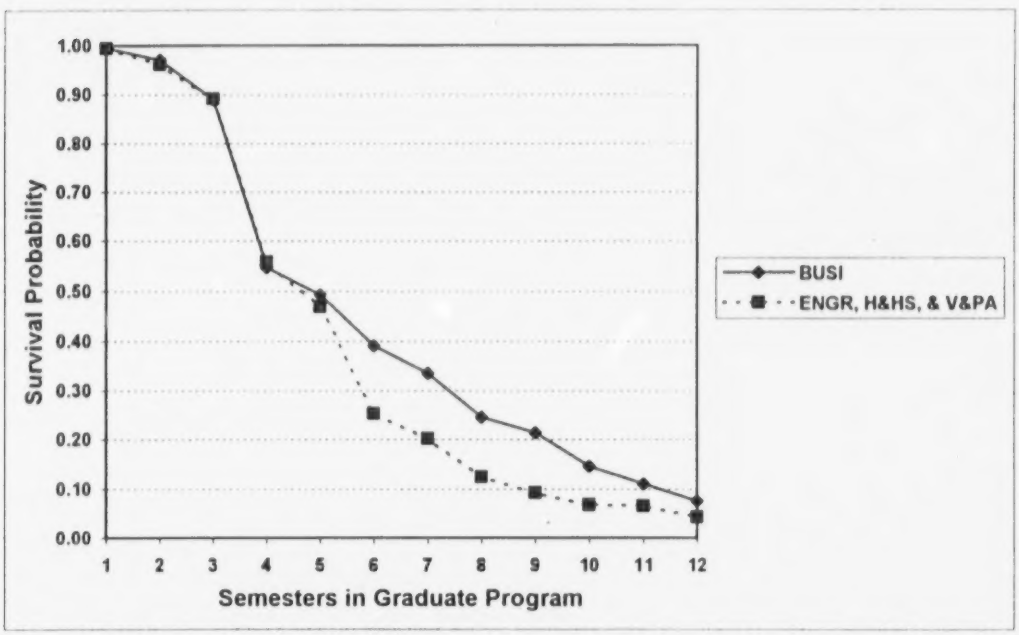
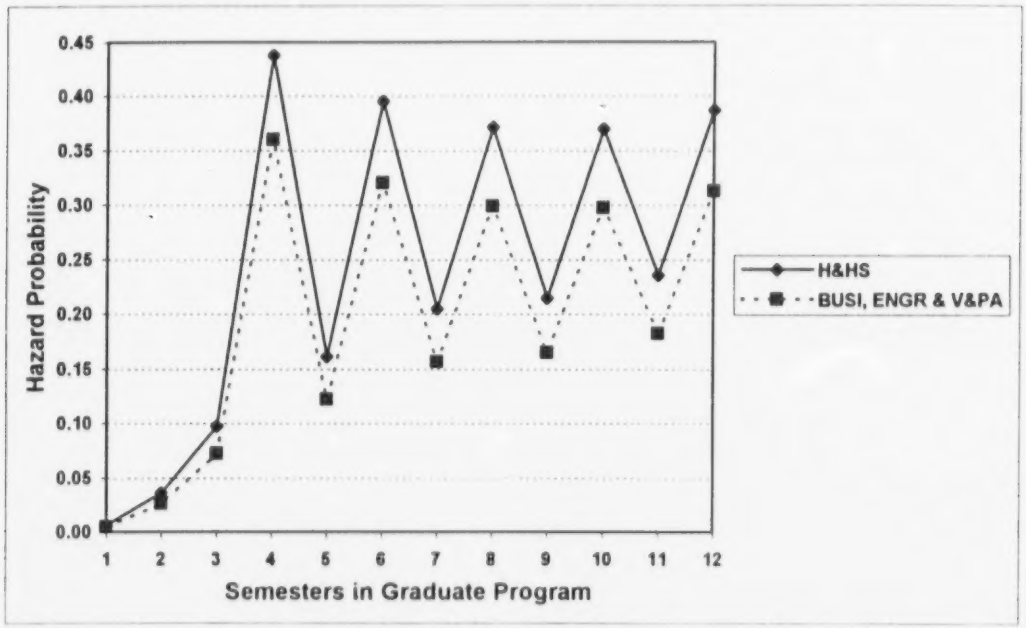


***Figure 2a*. Fitted harzard and survival functions describe the degree attainment process, from a hazard model containing the main effect of the time indicators and college: Business vs. the other three colleges.**



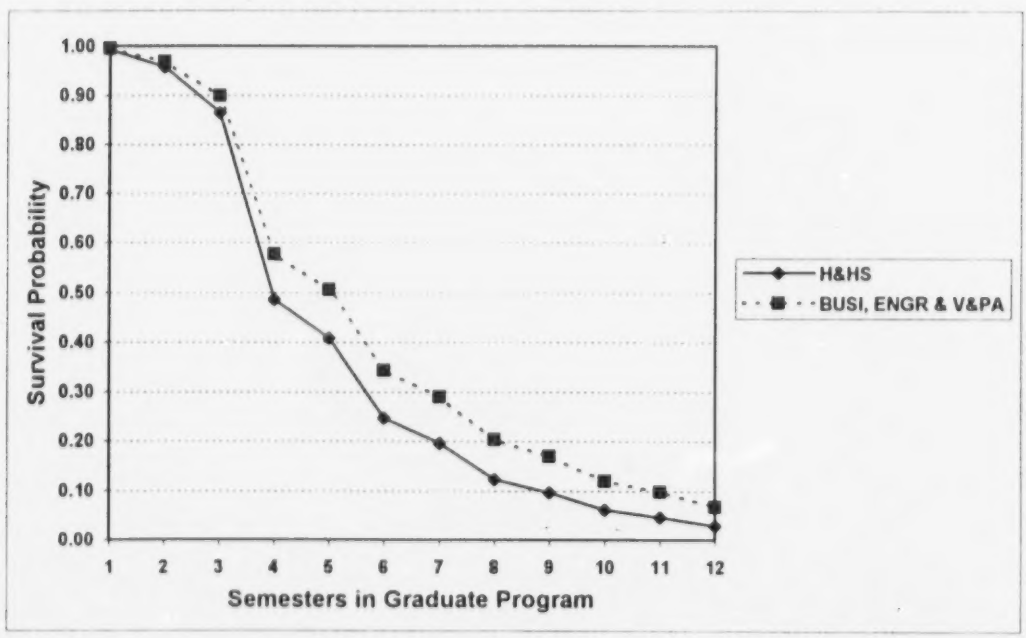


***Figure 2b*. Fitted harzard and survival functions describe the degree attainment process, from a hazard model containing the main effect of the time indicators and college: Health and Human Sciences vs. the other three colleges.**

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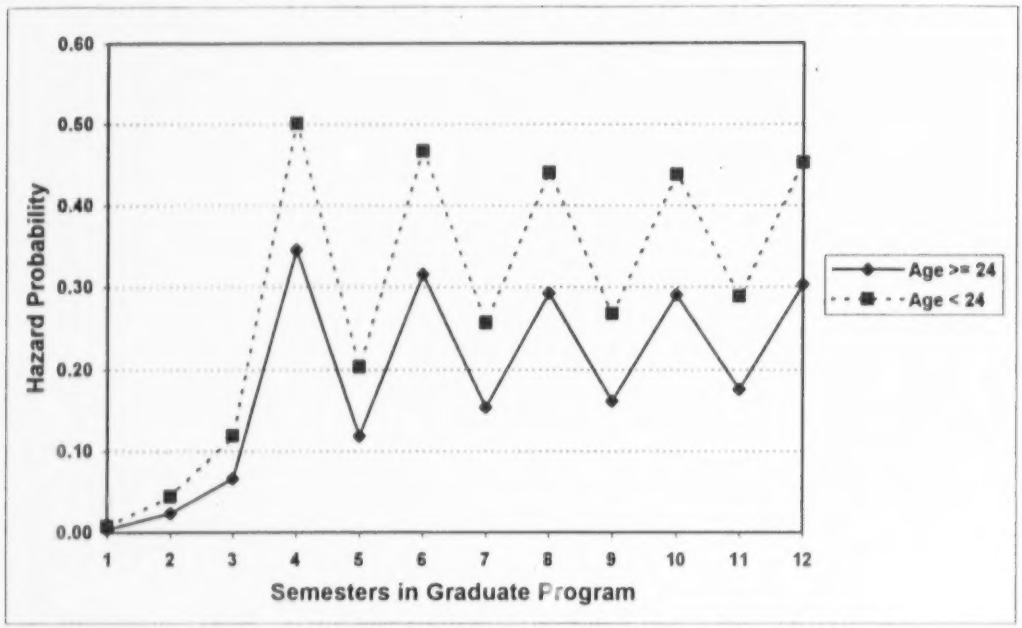


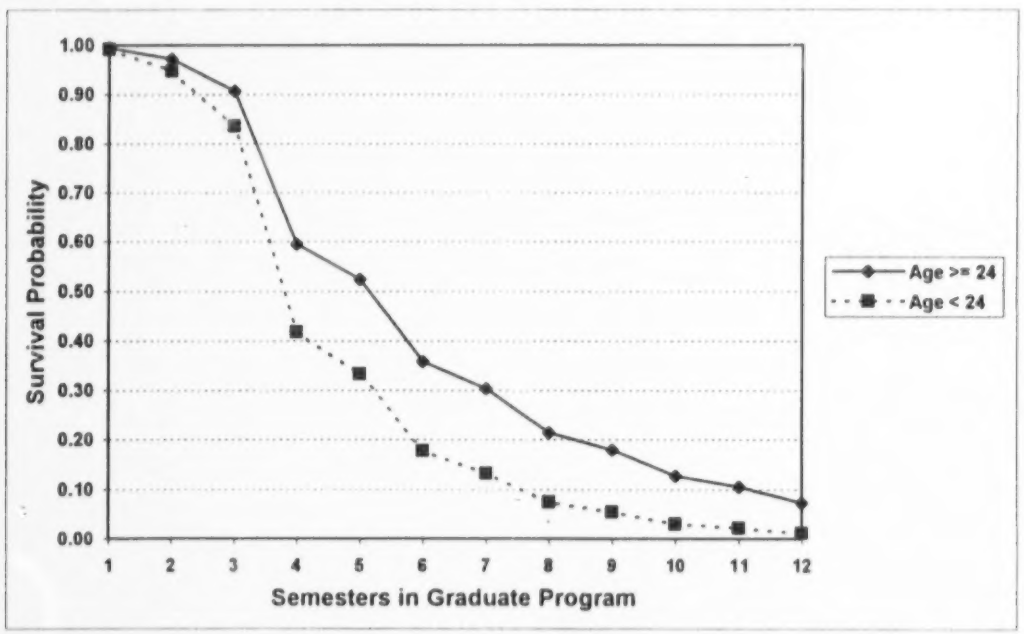
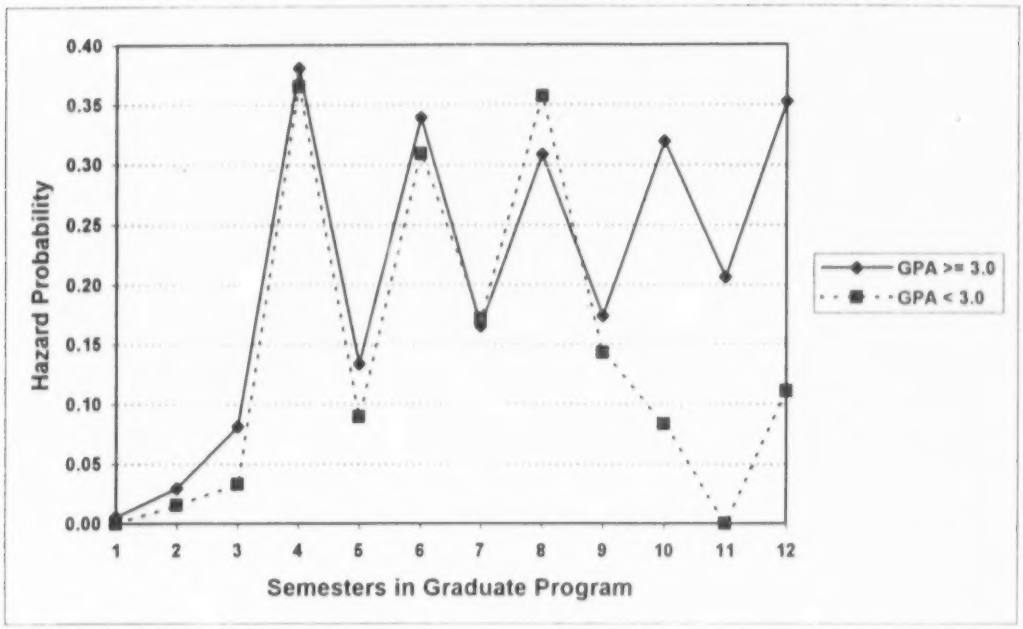


***Figure 3*.** **Fitted harzard and survival functions describe the degree attainment process, from a hazard model containing the main effect of the time indicators and age.**



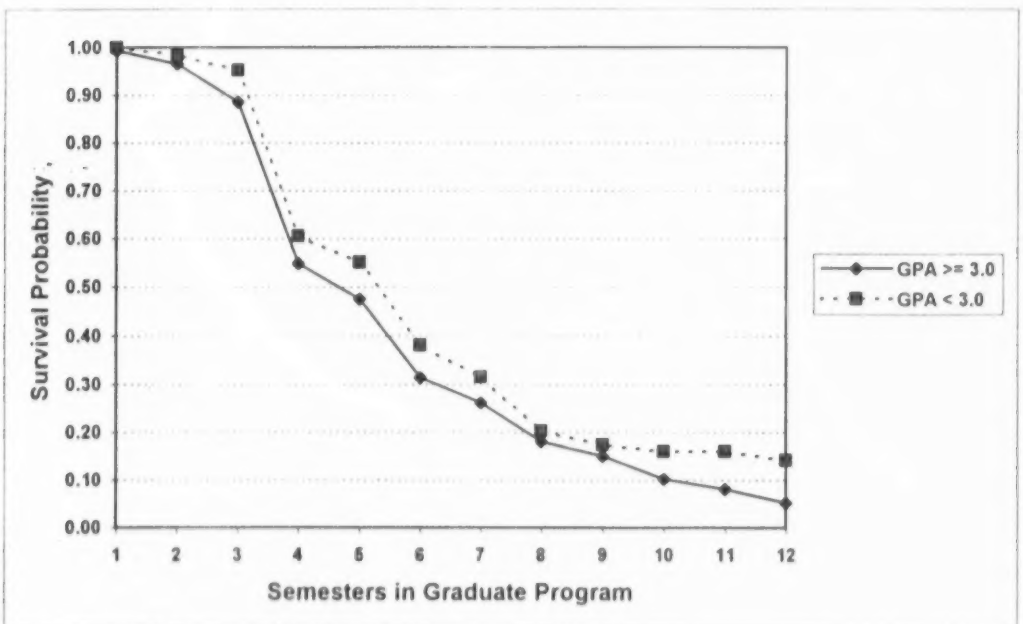


Figure 4. · **Fitted harzard and survival functions describe the degree attainment process, from a hazard model containing the main effect of the time indicators and the first semester cumulative GPA.**